National Semiconductor

100390
Low Power Single Supply Hex ECL-to-TTL Translator

General Description

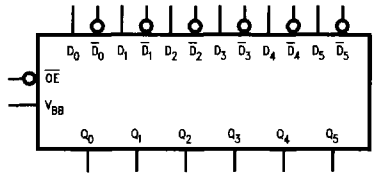
The 100390 is a hex translator for converting F100K logic levels to TTL logic levels. Unlike other level translators, the 100390 operates using only one +5V supply. Differential inputs allow each circuit to be used as an inverting, non-inverting, or differential receiver. An internal reference generator provides V_{BB} for single-ended operation. The standard FAST® TRI-STATE® outputs are enabled by a common active low TTL compatible $\overline{OE}$ input. Partitioned V_{CC}s on chip are brought out on separate power pins, allowing the noisy TTL V_{CC} power plane to be isolated from the relatively quiet ECL V_{CC}. The 100390 is ideal for applications limited to a single +5V supply, allowing for easy ECL to TTL Interfacing.

Features

- Operates from a single +5V supply
- TRI-STATE outputs
- 2000V ESD protection
- V_{BB} supplied for single-ended operation

Ordering Code: See Section 6

Logic Symbols

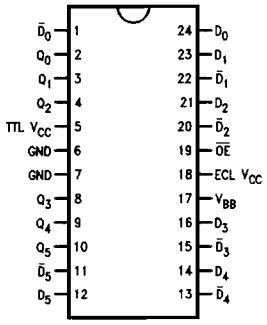


TL/F/10897–1

Pin Names	Description
D_0–D_5	Data Inputs (PECL)
$\overline{D}_0$–$\overline{D}_5$	Inverting Data Inputs (PECL)
Q_0–Q_5	Data Outputs (TTL)
$\overline{OE}$	Output Enable (TTL)
V_{BB}	Reference Voltage (PECL)

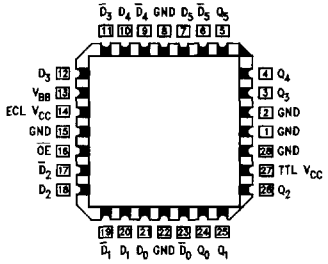
Connection Diagrams

24-Pin DIP/SOIC



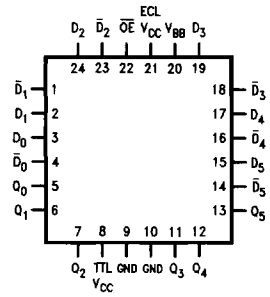
TL/F/10897–2

28-Pin PCC



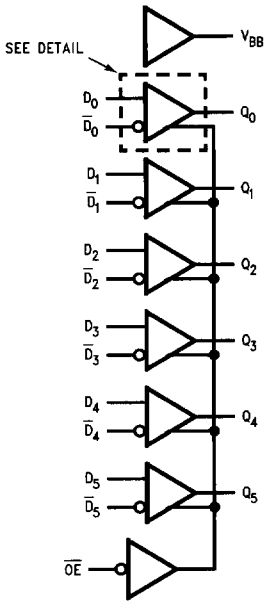
TL/F/10897–3

24-Pin Quad Cerpak



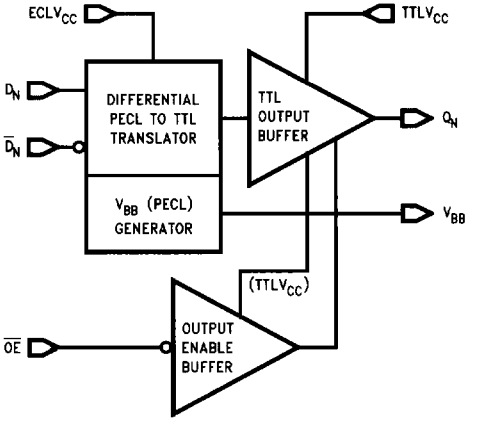
TL/F/10897–4

Logic Diagram



TL/F/10897–5

Detail



TL/F/10897–11

Truth Table

Data Inputs (PECL)		Control Input (TTL)	TTL Outputs	Comments
D_n	$\overline{D_n}$	$\overline{OE}$	Q_n	
X	X	H	Z	Outputs Disable
L	H	L	L	Differential Operation
H	L	L	H	Differential Operation
L	L	L	U	Invalid Input States
H	H	L	U	Invalid Input States
OPEN	OPEN	L	U	Invalid Input States
L	V_{BB}	L	L	Single Ended Operation
H	V_{BB}	L	H	Single Ended Operation
V_{BB}	L	L	H	Single Ended Operation
V_{BB}	H	L	L	Single Ended Operation
V_{BB}	OPEN	L	H	Single Ended Operation
OPEN	V_{BB}	L	L	Single Ended Operation

H = HIGH Voltage Level
L = LOW Voltage Level
Z = HIGH Impedance
U = Undefined

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature	−65°C to +150°C
Maximum Junction Temperature	
Ceramic	+175°C
Plastic	+150°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
TTL Input Voltage (Note 2)	−0.5V to +7.0V
TTL Input Current (Note 2)	−30 mA to +5.0 mA
V_{BB} Output Current	−5.0 mA to +1.0 mA
ECL Input Potential	GND to ECL V_{CC} + 0.5V
V_{CC} Differential ECL V_{CC} to TTL V_{CC}	−1.0V to +1.0V
Voltage Applied to Output in High State (with V_{CC} = 0V) TRI-STATE Output	−0.5V to +5.5V
Current Applied to Output in Low State (Max)	Twice the Rated I_{OL} (mA)
ESD Last Passing Voltage (Min)	2000V

Recommended Operating Conditions

Case Temperature	0°C to +85°C
Supply Voltage	+4.75V to +5.25V

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

DC Electrical Characteristics ECL V_{CC} = +5.0V ±5%, TTL V_{CC} = +5.0V ±5%, GND = 0V

Symbol	Parameter		Min	Max	Units	Conditions
V_{IH}	Input HIGH Voltage	Data	ECL V_{CC} − 1.165	ECL V_{CC} − 0.870	V	Guaranteed HIGH Signal for ALL Inputs (with One Input Tied to V_{BB})
		$\overline{OE}$	2.0		V	Guaranteed HIGH Signal (TTL)
V_{IL}	Input LOW Voltage	Data	ECL V_{CC} − 1.830	ECL V_{CC} − 1.475	V	Guaranteed LOW Signal for ALL Inputs (with One Input Tied to V_{BB})
		$\overline{OE}$		0.8	V	Guaranteed LOW Signal (TTL)
V_{BB}	Output Reference Voltage		ECL V_{CC} − 1.38	ECL V_{CC} − 1.26	V	I_{BB} = 0.0 mA or −1.0 mA
V_{OH}	Output HIGH Voltage (TTL)		2.7		V	I_{OH} = −3 mA
V_{OL}	Output LOW Voltage (TTL)			0.5	V	I_{OL} = 24 mA
I_{IH}	Input HIGH Current	Data		50	μA	$V_{IN} = V_{IH}$(Max), D_0–$D_5 = V_{BB}$, $\overline{D}_0$–$\overline{D}_5 = V_{IL}$(Min)
		$\overline{OE}$		20	μA	V_{IN} = 2.7V (TTL)
I_{IL}	Input LOW Current	$\overline{OE}$		−200	μA	V_{IN} = 0.5V (TTL)
I_{BVI}	Input Breakdown Current	$\overline{OE}$		10	μA	V_{IN} = 7.0V (TTL)
I_{CBO}	Input Leakage Current		−10		μA	V_{IN} = GND, D_0–$D_5 = V_{BB}$ $\overline{D}_0$–$\overline{D}_5 = V_{IL}$(Min)
I_{OZH}	TRI-STATE Current Output HIGH			50	μA	V_{OUT} = +2.7V
I_{OZL}	TRI-STATE Current Output LOW			−50	μA	V_{OUT} = +0.5V
I_{CC}	ECL Supply Current		13	30	mA	
I_{CCZ}	TTL Supply Current		10	20	mA	TRI-STATE
I_{CCL}	TTL Supply Current		8	17	mA	Low State
I_{CCH}	TTL Supply Current HIGH		0.4	2.0	mA	HIGH State
I_{OS}	Output Short-Circuit Current		−150	−60	mA	V_{OUT} = 0.0V, V_{CC} = +5.25
V_{Diff}	Differential Input Voltage		150		mV	Required for Full Output Swing
V_{CM}	Common Mode Voltage		ECL V_{CC} − 2.0	ECL V_{CC} − 0.5	V	
V_{CD}	Clamp Diode Voltage			−1.2	V	I_{IN} = −18 mA

DIP AC Electrical Characteristics

V_{CC} = 5.0V ±5%; T_C = 0°C to +85°C

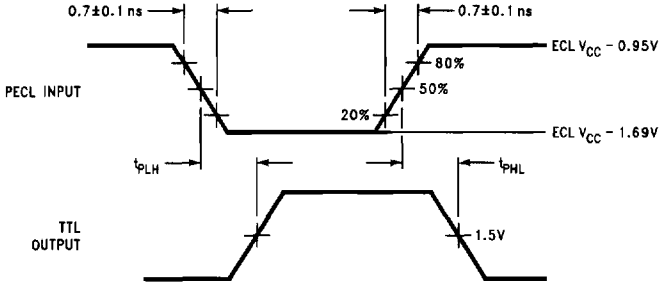
Symbol	Parameter	T_C = 0°C		T_C = +25°C		T_C = +85°C		Units	Fig. No.
		Min	Max	Min	Max	Min	Max		
F_{MAX}	Maximum Clock Frequency	100		100		100		MHz	
t_{PLH} t_{PHL}	Propagation Delay Data to Output	3.3	6.4	3.3	6.1	3.3	6.1	ns	1
t_{PZH} t_{PZL}	Output Enable Time	2.7 2.3	4.8 3.9	2.7 2.3	4.8 3.9	3.0 2.6	5.1 4.3	ns	2
t_{PHZ} t_{PLZ}	Output Disable Time	2.3 2.0	4.6 3.6	2.3 2.0	4.6 3.6	2.3 2.0	4.6 3.6	ns	2

SOIC, Cerpak and PCC Package AC Electrical Characteristics

V_{CC} = 5.0V ±5%; T_C = 0°C to +85°C

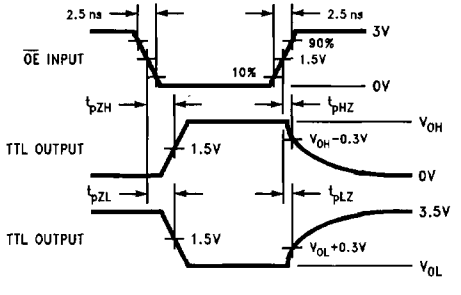
Symbol	Parameter	T_C = 0°C		T_C = +25°C		T_C = +85°C		Units	Fig. No.
		Min	Max	Min	Max	Min	Max		
F_{MAX}	Maximum Clock Frequency	100		100		100		MHz	
t_{PLH} t_{PHL}	Propagation Delay Data to Output	3.3	6.2	3.3	5.9	3.3	5.9	ns	1
t_{PZH} t_{PZL}	Output Enable Time	2.7 2.3	4.6 3.7	2.7 2.3	4.6 3.7	3.0 2.6	4.9 4.1	ns	2
t_{PHZ} t_{PLZ}	Output Disable Time	2.3 2.0	4.4 3.4	2.3 2.0	4.4 3.4	2.3 2.0	4.4 3.4	ns	2

Switching Waveforms



TL/F/10897–6

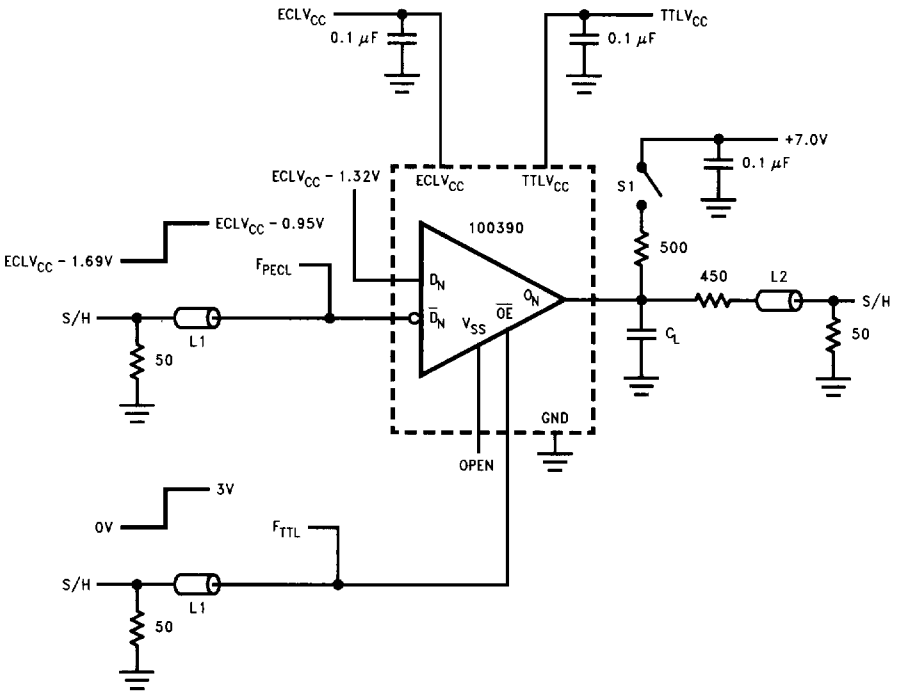
FIGURE 1. Data to Output Propagation Delay



TL/F/10897–10

FIGURE 2. Enable/Disable Propagation Delay

Test Circuit



TL/F/10897–7

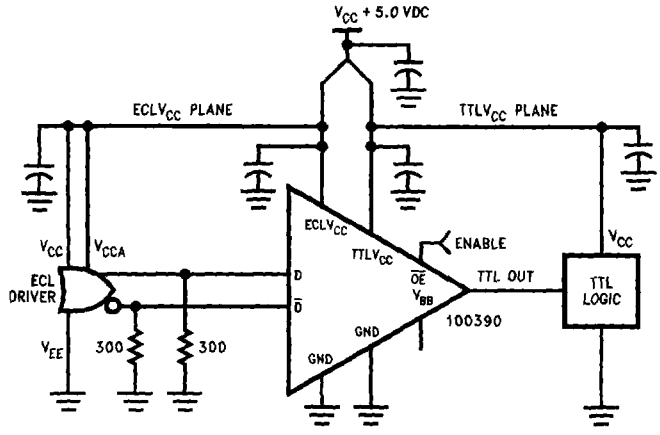
FIGURE 3. AC Test Circuit

Notes:
GND = 0V, ECL V_{CC} = +5V, TTL V_{CC} = +5V
L1 and L2 = equal length 50Ω impedance lines
50Ω terminators are internal to S/H measurement unit
Decoupling 0.1 μF from GND to ECL V_{CC} and TTL V_{CC}
All unused outputs are loaded with 500Ω to GND
C_L = Fixture and stray capacitance = 50 pF
Switch S1 is open for t_{PLH}, t_{PHL}, t_{PHZ} and t_{PZH} tests
Switch S1 is closed only for t_{PLZ} and t_{PZL} tests

Application Notes

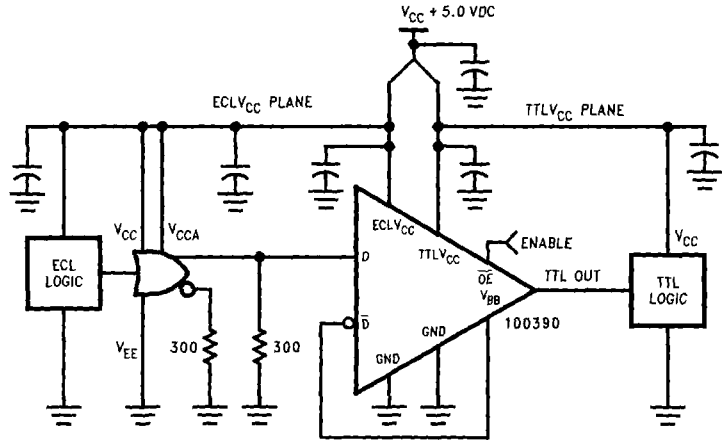
1. Device performance will be enhanced by the use of dual V_{CC} power planes as illustrated in the Application *Figures 4* and *5*. This will minimize the coupling of TTL switching noise into the primary reference to the ECL circuitry and take full advantage of the 100390's on chip V_{CC} partitioning.
2. The device's partitioned V_{CC} may be operated from two 5V, 5% tolerance, supplies provided that they are ramped up/down together so that the max differential is 1V. This is to prevent overstress to internal ESD diodes. If the ECL driver to the F390 is powered from a separate supply, it must obey this sequence rule also.
3. Glitch-free power up, independent of Data input levels, is achieved if TTL logic HIGH is held on the Output Enable pin during ramping up/down of the V_{CC} supply.
4. Undefined output states can occur for some invalid combinations. See Truth Table. This should be avoided to prevent possible oscillation or increased power consumption due to TTL outputs biased into a quasi state with both pullup and pulldown stages partially on. TRI-STATEing the outputs will counteract the effects of invalid input states.
5. Pins 8, 15, and 22 on the 28-pin PCC package are tied to the chip's substrate and are named GNDs. These pins are electrically common to the ground pins 1, 2, and 28. For best thermal performance, tie the GND pins to the circuit ground plane. They may be tied to an electrically isolated thermal dissipation plane or may float.
6. *Figure 4* illustrates typical differential input operation.
7. *Figure 5* illustrates typical single-ended input operation.

Application Notes (Continued)



TL/F/10897–8

FIGURE 4



TL/F/10897–9

FIGURE 5